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ABSTRACT

Theoretical models of the reading process have been proposed by F. Smith, E. J. Gibson and H. Levin, and D. LaBerge and S. J. Samuels. These models were examined using the following questions: How are features of print processed by the brain? How important are prior knowledge and expectations to the process (top-down or bottom-up processing)? Is meaning located primarily in the text or in the mind of the reader? Does the reader "decode to sound" and then to meaning, or go directly to meaning? Can reading be viewed as a summation of discrete acts, or is it a unitary process? Of the three models, the ones by Smith and by LaBerge and Samuels showed the greatest divergence, with Gibson and Levin's approach holding an intermediate position. Although none of the three models discussed has yet proven its superiority, comparison of the ways each model answers the foregoing questions sheds light on some intriguing issues in contemporary research on the reading process. Reading research has not yet produced one model that is "correct" or preferred above all others; but comparing different views can help identify and clarify the questions that are essential to understanding the reading process. (Author/RL)

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WHAT IS READING?

A COMPARISON OF THREE MODELS OF THE READING PROCESS

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Abstract

Three theoretical models of the reading process are compared: those presented by Smith (1971, 1975, 1977), Gibson and Levin (1975) and LaBerge and Samuels (1974). Differences and similarities between these three models, each of which attempts to explain what it is that the normal reader is doing when he is reading, are examined in relation to a series of questions: How are visual features in print processed by the brain? How important are the reader's prior knowledge and expectations to the process of taking in information from print? Is meaning located primarily in the text or in the mind of the reader? Does the reader "decode to sound" and then to meaning, or go directly to meaning? Can reading be viewed as a summation of discrete acts, or it is a unitary process? These questions have coninuing importance for reading research. Though none of the three models discussed has yet proven its superiority, comparison of the ways each model answers these questions sheds light on some intriguing issues in contemporary research on the reading process, both normal and disordered reading.

What is Reading?

A Comparison of Three Models of the Reading Process

Although each of us may believe that we know what we are doing when we read, in fact our knowledge of the process involved is quite limited. This is true not only of the layperson's knowledge about reading, but of educators' and psychologists'knowledge as well. As the rising numbers of school children (and adults) labelled "dyslexic" testify, our understanding of the reading process has not been sufficient either to tell where poor readers go wrong or to help them become good readers.

For decades, a large proportion of reading research was devoted to the cataloguing of differences between good and poor readers; the list of discovered differences was almost as long as it was unhelpful. More recently, the focus of research has moved toward a fuller examination of the normal reading process, to discover what it is that good readers are doing.

This research has generated a number of theoretical models of the reading process. Three such models will be compared here: those presented by Smith (1971, 1975, 1977), Gibson and Levin(1975)[1] and LaBerge and Samuels (1974). An examination of some of the similarities and differences between these approaches will serve to illuminate some important questions in reading research today.

Use of visual features in print

A point of agreement among these three models is that the brain's

processing of graphic information involves feature analysis. According to this view, the brain "decides" what letters and words are being read based on the presence or absence of certain distinctive features such as curvature, angles, intersections, etc., rather than by comparing the graphic display to an inner template of what each letter or word should look like (Smith, 1971, p. 109; Gibson & Levin, 1975, p. 15; LaBerge & Samuels, 1974, p. 296).

However, the three models differ in their description of how such distinctive features are used in reading.

Smith believes that featural information is sampled: in fluent reading, probably only a few features from each word or group of words are needed to provide enough information to read the text (Smith, 1971, pp.201-203). The brain uses other, non-visual sources of information to predict what will be read next (e.g. context, meaning, syntax); the eye is directed to look for only enough visual features to confirm or disconfirm these running hypotheses. If little non-visual information is available, due to the reader's inexperience or the difficulty of the text, more featural information is required. However, an increase in the number of visual features to be processed leads to a decrease in speed of reading, and probably in comprehension as well, due to overloading of short-term memory. Mediated reading--depending primarily on visual information, which is then decoded to words and to meaning--is the most difficult and least efficient form of reading, in Smith's view, precisely because of the strain on short-term memory.

Gibson and Levin agree that visual features are sampled rather than processed in their entirety (although they disagree with Smith on other points). They describe this sampling phenomenon as "the economy principle": the reader processes the least amount of information

compatible with his task, making use of redundancy in the text and his own prior knowledge in order to reduce the amount of featural information which is necessary. Irrelevant or unnecessary information is ignored (Gibson & Levin, 1975, pp. 474-480).

LaBerge and Samuels, on the other hand, believe that all of the features in a given graphic display are processed, either singly or as clusters of Gestalt-like units (LaBerge & Samuels,1974, pp. 296-301). LaBerge and Smuels' model is one of sequential information processing according to the following stages: selection of relevant visual features; construction of letter, spelling pattern and word codes from these features; association to phonological codes (speech); and association to meaning codes. Although through learning and practice this processing may become automatic, so that letters, words, word groups, and even meanings may be perceived without conscious attention being given to the intermediate steps (whereas in difficult reading, attention may be re-focused on lower stages in the process), nevertheless all of the information available in the visual display is utilized by the brain in reading what is written (Ibid., pp. 312-314). Samuels does refer in his earlier work to a "principle of least effort" (Samuels, 1967, 1968) according to which only the most salient cues or features are attended to in verbal learning if they are sufficient for making correct decisions. However, Samuels appears to apply this principle only to the initial process of learning to read, when the beginning reader is learning which features are the important ones to attend to: there is no suggestion in Samuels' work that features which the reader has learned to use as a basis for discrimination can be selectively ignored.

"Top-down" vs. "bottom-up" processing--or both at once?

These differences as to the use the reader makes of featural information in the written text are closely related to another question, which Adams, Anderson, and Durkin (1978) have described as differentiating "top-down" from "bottom-up" processing models.

The bottom-up approach says that readers rely primarily on the print, perceiving letters, words, phrases, and sentences in sequence. This approach probably corresponds to the layperson's "common sense" view of reading, and is shared by many educators and researchers. In contrast, the top-down approach says that readers read by forming hypotheses based on their knowledge of language and the world, and rely on print only to test these hypotheses; Adams et al. refer to Goodman's (1967) "psycholinguistic guessing game" as an illustration of this approach.

Adams et al. describe a third alternative which integrates the other two approaches: "top-down and bottom-up processing are seen to occur simultaneously, at least for a skilled reader". According to this combined approach, when a skilled reader comes to an unfamiliar word, he may either pause and sound it out, or use the meaning context of the word to decide what it is: both kinds of processes are available.

The model presented by LaBerge and Samuels is clearly a "bottom-up" approach. It pictures the reader as relying almost entirely on the print in order to decide what is being read: the reader's task is to decode the printed message.

Smith's model of reading has much in common with a top-down approach, at least as far as fluent reading is concerned. However, mediated reading --which is a bottom-up method--is an integral part of Smith's model. The reader has the option of moving between mediated and immediate

comprehension voluntarily: once fluent reading is achieved, mediated reading (used initially in learning to read) is still used in difficult reading. Thus Smith is actually presenting an integrated approach.

If Adams et al.'s three processing modes are viewed as describing three points on a continuum of possible models, with "top-down" on the left, "bottom-up" on the right, and an equally integrated model in the center, Smith's model would be situated slightly left of center. In other words, he sees both kinds of processing--top-down and bottom-up--as integral to the reading process, but places somewhat more emphasis on the reader's non-visual information as directing the fluent reader's activity.

Gibson and Levin's model also views both kinds of processing as important, but places more emphasis on print-decoding skills than Smith's does. On the same continuum described above, their model would be positioned slightly right of center.

On the one hand, Gibson and Levin dismiss the hypothesis-testing, guessing-game approach as implying "either a phenomenology of reading activity which is certainly invorrect, or a metaphorical way of speaking which is...unenlightening " (Gibson & Levin, 1975, p. 478). On the other hand, they also reject a strict stage model progressing from "stimulus input at the beginning to a response output at the end" (Ibid., p. 481). They view reading as a somewhat flexible process, with the reader directing attention selectively from one level of features to another, depending on the difficulty of the task and the purpose of the reader. The amount of work or decoding to be done varies with the amount of uncertainty that can be reduced by using foregoing structure in the text and "old information", both conceptual and linguistic (Ibid., pp. 481-482). This approach is similar to Smith's, and is in fact a variant of the hypothesis testing category. However, the basis on which the

reader's hypotheses are formed is confined in this model to the structural information provided by the text along with the reader's pre-existing knowledge strictly relevant to interpreting that information.

Meaning: in the print or in the reader?

Another closely related question has been described by Olson (1977) as concerning the location of meaning:

> Theories of reading and learning to read can be seen as expressions of the rival assumptions about the locus of meaning. In one view the meaning is in the text and the student's problem is to find out how to decode that meaning....The alternative view is that readers bring the meaning to the text, which merely confirms or disconfirms their expectations (Ibid., p. 262).

LaBerge and Samuels take the first view; they describe the reading process as "the journey taken by words from their written form on the page to the eventual activation of their meaning" (LaBerge & Samuels, 1975, p. 293).

Olson also places Gibson and Levin's (1975) model in this category of locating meaning in the text. Their model is more difficult to categorize than LaBerge and Samuels', since Gibson and Levin do concede that the reader's prior knowledge of the world may aid him in deriving meaning from the text. However, in balance, Olson's categorization of this model is probably correct. Gibson and Levin describe reading as "extracting information from text"(Ibid., p.5). While fluent readers may go "directly to the abstract meaning for which the text is only a notation" (Ibid., p.

476), the authors reject the view that the reader is "operating at the level of the general meaning of the message" (Ibid., p. 450).

Olson places Smith's model in the second category, as locating meaning in the reader. This also seems a generally correct categorization. Smith says "in my view, reading is not a matter of decoding letters to sound but of bringing meaning to print" (Smith, 1977, p. 387). In fact, he says, "comprehension of meaning normally precedes word identification" (Smith, 1971, p. 195):words can best be identified if the meaning of the phrase is comprehended first. This is most obvious in reading aloud, when the pronunciation of ambiguous words (e.g. permit, minute, read) and the intonation of the sentence frequently depend on the meaning of the sentence (Smith, 1975, pp. 180-184). As pointed out before, Smith views mediated reading, in which meaning is primarily derived from decoding of print, as extremely inefficient: because of slowness of processing by this method, comprehension becomes nearly impossible due to limitations on the brain's short-term memory capacity.

Of course it is an exaggeration to say that Smith views <u>all</u> the meaning as located in the reader: one of the main purposes of reading is to find out what the author has to say, and add to the reader's knowledge. One suspects that Smith's statements are at times purposely provocative, overstating his case in order to show that the "common sense" view of reading has serious inadequacies. His central message is that the reader's ability to use prior knowledge of the subject as well as of the laws of syntactic and orthographic redundancy is an essential part of his ability to read quickly and to directly comprehend the meaning of the passage. The difference between this approach and that of

Gibson and Levin is again primarily one of emphasis: Smith places greater emphasis on the meaning that the reader brings to his reading than Gibson and Levin do.

Decoding to sound

Another question on which these models differ is whether the reader translates written text into a kind of internal speech from which he derives meaning, or does he bypass this speech component to derive meaning directly?

In LaBerge and Samuels' model, recoding into phonological codes (at the level of the letter, spelling pattern, word, or word group) is one of the postulated stages. This phonological recoding occurs with attention when reading is being learned initially or when a new word is encountered; it can occur automatically (i.e. without conscious attention) in a fluent reader. Initial learning of associations between visual patterns and phonological responses occurs on an all-or-none basis. Once the phonological word code is activated, "we assume that the meaning of the word can be elicited by means of a direct associative connection between the phonological unit...and the semantic meaning unit", using associations acquired in learning spoken language (LaBerge & Samuels, 1974, p. 307). They do note the possibility that "a visual word code may be associated directly with a semantic meaning code" (Ibid., p. 308); they suggest however that this only happens with very common words and serves primarily to distinguish homonyms such as "two/too" or "bear/bare".

Smith, on the other hand, claims that "direct translation of symbols to sound is not only unnecessary ...but fundamentally impossible" (Smith, 1975, p. 179). He says that it is only possible to decode to sound (i.e.

read aloud) if meaning is used as an intermediary. Many words are pronounced differently but spelled the same, as shown by these sentences:

He winds his watch while the children read.

I read yesterday that the winds would be strong.

"How could we read these sentences aloud correctly unless we articulate the words on the basis of meaning?" says Smith (1975, p. 181).

Smith further points out that examples such as this show that reading is not simply a matter of going from left to right, reading one word after another: information later in the sentence is crucial to pronunciations early in the sentence(Ibid., p. 183). This is also true of pronouncing individual words: letters or letter groups later in the word often determine the sound of earlier graphemes (e. th in " father" and fathead"; n after p, g, or k as in "pneumonia","gnash", or "knot"). He adds that most phonics rules apply only if the word is decoded from back to front, and then can only really be applied if you already know what the word is--from other cues (Ibid., p. 184).

Smith also disagrees that activation of the sound of the word automatically means that its meaning is comprehended. He refers to the "widespread misconception that spoken words have a kind of magical character; that their meaning is apparent the moment they are uttered. Therefore, all one has to do to acquire the meaning of written words is to convert them into vocal or subvocal speech"(Smith, 1971, p. 207). He refers to Chomsky's concept of deep and surface structure of language; Smith views print as another form of surface structure, parallel to but independent of speech. In other words, print is not simply a notation for speech, nor is it necessary to convert written to spoken language in order to comprehend its

meaning. "Writing does not require speech in order to be understood" (Smith, 1975, p. 180).

Gibson's views on this question appear to have evolved in the past few years. In 1970 she wrote, "the heart of the matter [reading] is surely the process of decoding the written symbols to speech" (Gibson, 1970, p. 139). However, by 1975 she rejected this view as an "oversimplification"(Gibson & Levin, 1975, p. 109) and declared that "reading is not simply the decoding of written symbols to sound" (Ibid., p. 5). In discussing skilled reading, Gibson and Levin say that "adults reading silently to themselves bypass subvocalization and go directly to the abstract meaning for which the text is only a notation"(Ibid., p. 476).

However, there is greater emphasis in Gibson and Levin's approach on the learning of spelling patterns and other orthographic regularities in print which represent particular phonemes and sound clusters, than is the case in Smith's approach. It seems unlikely that Gibson and Levin would go as far as Smith in declaring the printed message to be independent of speech. They state that although the correspondence between phonemes and letters is not a direct one, still it is a systematic and rule-governed relationship, mediated by meaning. They emphasize the importance of spelling-to-sound correspondences at the lexical level [a level intermediate between Chomsky's deep and surface structure] both for pronunciation and for comprehension of word meanings (Ibid., pp. 180-182).

Is reading more than the sum of its parts?

Finally, these models differ on the question of whether reading--and reading instruction--can usefully be broken down to a series of subordinate skills.

LaBerge and Samuels clearly believe that it can. They say, "we view reading acquisition as a series of skills, regardless of how it appears to the fluent reader. Pedagogically, we favor the approach which singles out these skills for testing and training and then attempts to sequence them in appropriate ways"(LaBerge & Samuels, 1974, p. 318). The series of skills described in their model includ: learning of scanning strategies to find distinctive features; construction of letter, spelling pattern, and word codes; learning of associations between these codes and phonological codes, including "blending" of sounds into word units. They point out that other skills, such as parsing and predictive processing, are not yet spelled out in their model, but presumably are important skills to learn as well.

Smith holds the opposite view. He says, "while it is true that a child needs the intermediate skills of mediated word and meaning identification....it is not necessary that he learn them all before he gets on with the major objective of immediate comprehension"(Smith, 1971, p. 226).

Smith seems to believe that fluent reading is a qualitatively different process from mediated reading: fluent reading involves immediate comprehension of meaning without the intermediate steps of letter- or word-identification used in mediated reading. "Fluent readers can extract meaning from passages at a rate that would absolutely preclude word identification"(Ibid., p. 203). Furthermore, in Smith's view this process is not simply the result of gradual improvement in mediated identification skills resulting in them becoming automatic, as LaBerge and Samuels believe. On the contrary, says Smith, "it is only when the larger part

of reading can be accomplished immediately that the reader can afford to stop and use, or learn, mediated reading skills" (Ibid., p. 226). Mediated reading, used alone, places such a high burden on memory that comprehension is lost.

Smith makes relatively few prescriptions about what reading instruction should consist of, apart from a great deal of experience in actual reading: "reading can be learned only through reading"(Ibid., p. 186). He insists that most of the skills necessary to mediated reading and to becoming a fluent reader cannot be separately taught or drilled into students, primarily because we are not aware, on a conscious level, of what these skills are. For example, no one knows what the distinctive features are to which the eye and brain attend in distinguishing one letter from another (though, on an unconscious level, all good readers "know" what these features are). A child learns such skills, in Smith's view, by being exposed to reading material and by being given feedback as to whether he has made correct discriminations or not. "Only by reading can a child test his hypotheses about the nature of the reading process, establish distinctive feature sets for words, learn to identify words and meanings with a minimum of visual information and discover how not to overload the brain's information-processing capacity and to avoid the bottlenecks of memory" (Smith, 1975, p. 185).

Gibson and Levin's approach is somewhere betwwen the other two on the question of breaking reading down into subordinate skills.

On the one hand, they reject sequential, information-processing models such as LaBerge and Samuels', although they consider LaBerge and Samuels' version of this approach to be "more realistic [than other information-processing models] in recognising the flexibility of reading processes" (Gibson & Levin, p. 477). They hold than "when teaching a

complex task [such as reading] it is preferable to start training on the task itself, or a close approximation to it, rather than giving training on each component skill independently and then integrating them" (Ibid., p. 324).

On the other hand, they do not appear to view skilled reading as qualitatively different from beginning reading. The implication, thought never explicitly stated, is that all that is required for a beginning reader to become a fluent reader is to do more of the same kind of thing that he is doing already, only to do it better and more efficiently. In other words, skilled reading is a kind of speeded-up or automated mediated reading. In this respect, Gibon and Levin's views are closer to those of LaBerge and Samuels than to Smith's.

The instructional approach favored by Gibson and Levin is a "multilevel" one, simultaneously training the child to use spelling-to-sound correspondences and spelling pattern constraints, grammatical structure, and the meaningful context of the passage. They place more emphasis on structured instruction than Smith does, particularly on instruction in intraword relations such as relational spelling patterns. However, they emphasize that simply verbalizing the rules does not serve much purpose: the child must be helped to discover the useful structures himself. They do share Smith's view that the child should get as much opportunity to read as possible, right from the beginning:"a child should be set going on his own as soon as possible. Opportunity to look at any book he chooses, whether he literally 'reads' it or not, seems essential" (Gibson & Levin, 1975, p. 267).

Summary

Of the three models of the reading process compared here, the two presented by Smith and by LaBerge and Samuels show the greatest divergence, with Gibson and Levin's approach holding an intermediate position.

Gibson and Levin share many of Smith's views: that featural information is sampled rather than processed in its entirety, that the reader uses structural information in the text as well as his own knowledge to reduce the amount of decoding work necessary to reading, that decoding to sound is not necessary in the fluent reader, and that it is not useful to view reading as a series of separate skills which are then taught separately.

However, Gibson and Levin are closer to LaBerge and Samuels on some questions. Gibson and Levin place less emphasis on the reader's use of meaning in decoding the text than Smith does (and do not state, as Smith does, that meaning is necessary before decoding to sound can be done, at least in many instances). They also tend to share LaBerge and Samuel's gradualist view of the transition to fluent reading: that beginning reading and fluent reading are essentially the same process, and that practice in mediated reading skihls is essentially all that is required for fluent reading to be acquired. (Smith, on the other hand, views mediated and fluent reading as different processes; the relationship between the two is a complex and somewhat indirect one.)

On the instructional level, it appears that classrooms directed according to Gibson and Levin's approach would be more like ones run according to Smith's views--with emphasis on the child actually reading meaningful text right from the beginning, although with perhaps more structured exercises than Smith would include--than like classrooms programmed according to

LaBerge and Samuels' views. The latter would focus on learning a number of separate skills and gradually integrating them and practicing them to make them automatic.

Reading research has not yet reached the point where one model can be declared "correct" and others discarded. However, it is hoped that the contrast and comparison of differing views can contribute to further clarification of the questions involved in understanding the reading process.

Footnote

1. Although Gibson and Levin (1975) declare that they do not present a model for reading, they do present a list of principles which will be treated as such in this paper.

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